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Exploring the policy space for public health in large-scale mining in Burkina Faso: A Q-methodology study

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ABSTRACT

Large-scale resource extraction may lead to significant negative externalities on the environment, social well-being and public health. Negative environmental impacts of extractive projects are regularly considered through mandatory environmental impact assessments; however, public health impacts frequently remain unaddressed due to a lack of legal requirements, particularly in Africa where many resource extraction projects are being implemented. While policy instruments are available to mitigate negative externalities on public health - the most eminent being the Health Impact Assessment (HIA) - such instruments have not been widely established. We use Q-methodology to explore the policy space available to advance public health in large-scale mining projects in Burkina Faso. A Q-methodology study is purposeful as it allows to reveal common ground between government, private sector and civil society stakeholders on whose support successful policy initiatives depend. We identify two broader stakeholder perspectives that reveal an overarching consensus on the need to regulate health impacts of mining projects. Both perspectives reject industry self-regulation and broadly agree on introducing HIA as a regulatory instrument, but also point to different priorities and focal points among stakeholders. We develop a conceptual framework to map stakeholders' shared and divergent policy preferences. The findings can help to initiate a policy dialogue on safeguarding public health in large-scale mining projects and may guide policymakers to implement public health policy reform.

1. Introduction

Mining has become a major source of revenue for many countries across Africa. With the progressing digitalization of the economy and the energy transition, the importance of mining will further increase (IEA, 2021). While mining offers opportunities to advance the Sustainable Development Goals (SDGs), it does not come without risks, including for the country's economy and particularly for the environment and public health in mining areas. To minimize environmental damage, most countries have some form of legislation in place that requires the use of environmental impact assessments (EIA) in large-scale mining projects (Richard, 2012; UN Environment, 2018). Yet, this is not the case for public health, especially in Africa (Winkler et al., 2020). Research shows that, in the absence of regulatory requirements, mining companies consider public health to a very limited extent and only when conducting EIAs (Dietler et al., 2020; Engebretsen and Brugger, 2021).

The prevailing EIAs tend to focus on environmental determinants of health while frequently neglecting social and institutional health determinants. The consideration of health determinants further decreases when it comes to the mitigation and monitoring measures spelled out in management plans. Especially, the capacity of and access to local health services often remains disregarded, as well as individual health risk factors. Moreover, current impact assessments in Africa usually consider only a small number of health outcomes (e.g., HIV, malaria, injuries), often disregarding non-communicable and vector-borne diseases, among others (Dietler et al., 2020). This neglect is particularly problematic in mining areas that witness high in-migration and rapid population growth, leading to the (unregulated) emergence of urban

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settlements (Abah, 2012; Bryceson et al., 2022; Jønsson et al., 2019). Furthermore, there are significant variations in company performance when it comes to carrying out impact assessments, with some largely neglecting health considerations, while even the best-performing ones do not carry out a comprehensive assessment of public health risks and impacts (Engebretsen and Brugger, 2021).

In theory, policy tools are available to assess and mitigate negative externalities on public health, the most eminent being the Health Impact Assessment (HIA) (Harris-Roxas et al., 2012; IFC, 2009; Thondoo and Gupta, 2020). Modelled on the concept of EIA, an HIA is conducted prior to the start of the mining project to inform project design (Fig. 1). In a full-fledged HIA, health is considered as a comprehensive, stand-alone approach that starts with a baseline assessment of public health determinants and outcomes, followed by a risk assessment that investigates how mining activities are likely to affect determinants and outcomes. From this, a health action or health management plan is derived. Recommendations form the core of the management plan. However, the plan also determines authority, assigns responsibility for implementing each recommendation, establishes a monitoring plan, including appropriate indicators, and creates or suggests mechanisms to verify that assigned responsibilities are being met. Through its management plan, the HIA becomes the linchpin for steering and monitoring mining operations in a public health-sensitive manner. Mining firms, government agencies and local health departments may all be able to implement measures recommended in a health management plan (National Research Council (US) Committee on Health Impact Assessment, 2011).

The quality of an HIA is determined by its scope (in the ideal case considering the full range of individual, social, environmental, and institutional determinants and outcomes of public health along the entire process) and by its depth (the collection of primary data and the consultation of affected communities, local health experts and decision makers when establishing the baseline and, later, when conducting monitoring). Comprehensive HIAs can also help closing prevailing health equity gaps by stratifying affected communities into subgroups and addressing health differentials. Initial reports suggest positive effects on the health of vulnerable population groups when extractive industries commission rigorously conducted HIAs (Leuenberger et al., 2019). While a full-fledged HIA is a mandatory requirement for mining projects in only a few countries globally, including Canada, New Zealand, and Australia (Winkler et al., 2013), no African country has comprehensive formal requirements on whether and how to consider public health in the licensing process for large-scale mines.

Public health regulation in mining can take many forms, with a full-fledged mandatory HIA being just one – and the most demanding – option. Considering a limited range of health aspects within the framework of EIAs or other types of impact assessment is also a possibility (Dietler et al., 2020). For countries aiming to improve the public-health sensitivity of mining operations, a gradual approach to regulating public health might offer a pragmatic route to finding sufficient support for implementation across stakeholders.

Several questions arise from a policy perspective: first and foremost, do stakeholders see a need for action? Do stakeholders in the industry, in the ministries of health, mining or environment, or from civil society support strengthening public health considerations in industrial mining? If so, what policies should - in the view of stakeholders - be prioritized, and how stringent should measures be? Finally, which actors – mining companies, government agencies, local administration – should be involved and who is responsible and to be held accountable for what?

We study these questions for the case of Burkina Faso. The country has witnessed the start of 17 industrial mining projects in the last 15 years but has no public health regulation integrated into the mining licensing process. At the same time, several communities near large-scale mines have reported suffering from a variety of adverse public health effects, at times leading to conflict (Drechsel et al., 2019). Our research illuminates the complex interplay between public health considerations and large-scale mining operations in a developing nation, offering valuable insights regarding the potential benefits and challenges of incorporating HIA and the significance of stakeholder perceptions. Given the prevalence and ongoing relevance of large-scale mining across Africa, our findings may unveil viewpoints and areas of contention that extend beyond Burkina Faso's context.

Our findings provide an exemplary illustration of how the adoption of HIA can be both beneficial and challenging. Policymakers and stakeholders in other resource-rich developing countries can draw lessons from Burkina Faso's experience in grappling with the policy implications of incorporating HIA into mining regulations.

We use Q-methodology to explore different perspectives among stakeholders on public health regulation in the context of large-scale mining projects. Our Q-study aims to discern areas of agreement and disagreement across different stakeholders with regard to different policy options. We find that all stakeholders from the ministries of mining, environment and health, mining companies, and civil society believe that public health is currently under-regulated and needs more attention without going so far as to advocate for a full HIA legislation. Stakeholders also agree that public health cannot be left to the companies' discretion and that the public sector must play a key regulatory role. Beyond this agreement, we find two distinct procedural preferences on how public health should be integrated. One focuses more on a top-down approach, and the other emphasizes coordination and inclusion of all stakeholders in defining the relevant public health issues to be considered in a mining project.

In section two below, we develop a framework to conceptualize the gradual regulation of public health considerations. Section three introduces Q-methodology that we use to elicit stakeholder preferences towards amending mining regulation in favour of public health. In section four, we present the results from factor analysis, followed by their interpretation in section five. Section six discusses the findings and section seven concludes.

2. Conceptual framework

To elicit stakeholder priorities and support for regulating public health, we develop a conceptual model based on the HIA process framework as presented above (Fig. 1), as well as based on a review of relevant literature on HIA design and implementation. We unpack the constitutive components of the HIA process into a three-by-four matrix (Table 1). On the x-axis, we position the three generic content elements: (1) *situation assessment and risk analysis* (the health determinants to be included, the kind of data to be collected, the consideration of potential public health impacts, their severity and probability); (2) *health management* (identification of measures to be taken at project design, during operations, including preventive measures, health service provision, and measures following mine closure); (3) *monitoring and enforcement* (the salient indicators to observe the implementation of measures and assess public health outcomes to inform corrective action as well to enforce compliance).

On the y-axis, we position four key properties that define each content dimension: first, *scope: what should be covered by policy measures?* Measures can be absent (*e.g.*, no risk analysis is undertaken or no monitoring required), minimalistic, moderate, or extensive (as in a full-fledged HIA). While an extensive implementation of all these measures likely delivers the best public health outcomes, it requires high capacity and resources. In contexts of limited capacities and resources, policy actors may thus opt for less ambitious measures.

Second*, stringency: how mandatory should policy measures be?* Regulators have different options to steer behavior, ranging from voluntary encouragement to offering incentives in exchange for compliance, up to establishing mandatory requirements. For example, regulators may specify preconditions for obtaining a mining license or introduce sanctions for non-compliance. As different options involve different costs for both sides, policymakers tend to consider stringency in a broader context, which often involves preference choices; for example, when focusing on encouraging investment in mining, less strict requirements

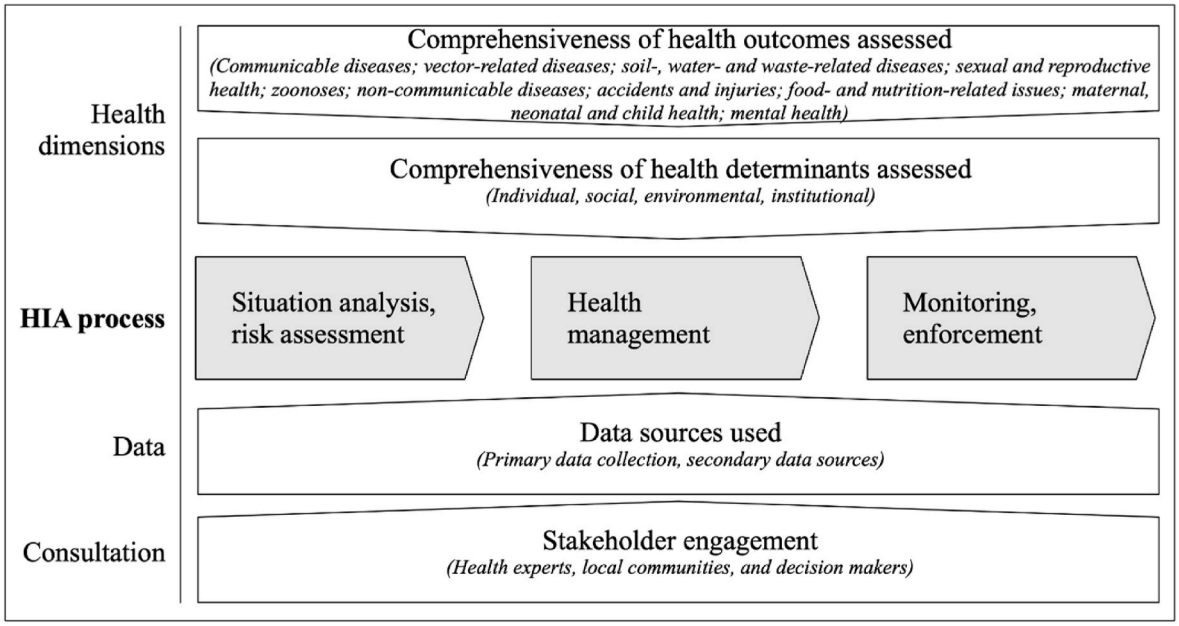

Fig. 1. HIA process framework (source: authors, adapted from IFC, 2009).

may seem preferable.

Third, *actors: who should be responsible for different measures targeted by regulation?* Policies can place different actors under obligation while saving others costs and efforts. In the area of public health, views may differ on what responsibilities should lie with the central or regional government, with the mining companies, or with local health service providers.

Fourth, *coordination: how should actors across institutions and sectors coordinate and who should be included in decision making?* The question of coordination addresses, among others, the issue of who's knowledge needs to be considered when assessing the public health situation, conducting risk analysis, or carrying out monitoring; for example, whether and to what extent local-level health professionals and affected communities need to be consulted. It also concerns transparency, *i.e.*, access to and exchange of information as well as cooperation between public and private actors but also within the public sector both horizontally and vertically.

To complete the assessment framework, we add to the content elements two regulatory options, (a) *integration* of public health provisions into the existing EIA legislation or (b) *stand-alone regulation* through legislation of a separate HIA, as discussed in the pertinent literature (see, for example, Abah, 2012; Bhatia and Wernham, 2008; Dietler et al., 2020; Tarkowski and Ricciardi, 2012).

As outlined below, this conceptual framework has guided the composition of policy options through systematic analysis of existing impact assessment regulations in Burkina Faso and is used further below as a heuristic matrix to depict the policy preferences as reflected in the identified stakeholder perspectives (see Table 4 below).

3. Methodology

Q-methodology (short Q) is a methodology that allows for the systematic study of human subjectivity, combining both quantitative and qualitative research techniques (Brown, 1980; McKeown and Thomas, 2013; Stephenson, 1993; Van Exel and De Graaf, 2005; Watts and

Table 1
Conceptual framework.

		Content: what should be the focus of public health policy?			***Regulation: how should public health be included in the legal framework?***	
		Situation analysis and risk assessment: *Determinants, data to be collected, impacts on health outcomes, severity, probability*	**Health management:** *Project design, prevention, service provision, mine closure*	**Monitoring and enforcement:** *indicators, public health outcomes, compliance*	**Integrated approach:** *Build on and expand existing legislation for licensing and impact assessment*	**Stand-alone approach:** *Introduce separate legislation for HIA*
Properties that define each content element	***Scope:*** *What should be covered?*	Absent, minimalistic, moderate, extensive			Public health provisions are integrated into the existing (EIA) regulatory and legal framework.	Public health provisions are enshrined in a separate HIA regulatory and legal framework.
	Stringency: *How mandatory should policies be?*	Voluntary, incentivized, mandatory				
	Actors: *Who should be responsible for different measures and targeted by regulation?*	Central government vs local government vs mining companies				
	Coordination: *How should actors across institutions and sectors coordinate, and who should be included in decision-making?*	Inclusion of local population and health experts, role of ministries and central/ local levels, (public) sharing of data				

Source: authors.

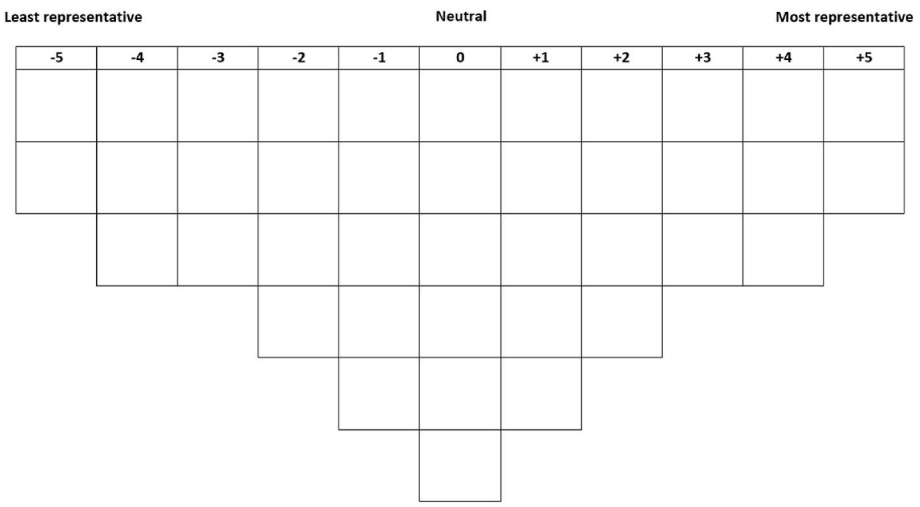

Fig. 2. Q-sorting grid (source: authors).

Stenner, 2005, 2012). As such, Q is a useful tool to systematically characterize how different groups of people think about a particular issue. Q-studies have been applied across different disciplines and are increasingly used in the field of policy analysis, especially because of their utility in informing political decision-making (Alderson et al., 2018; Brown, 2019; Molenveld, 2020; Sardo and Sinnett, 2020; Zabala, 2014).

In Q-studies, participants are asked to rank a set of predefined statements that are "broadly representative" of the population of relevant viewpoints or "opinion domain" of the topic of interest (Watts and Stenner, 2005: 75). The statements are typically displayed on cards which are then sorted onto a continuum in accordance with participants' preferences (see Fig. 2 below). To make it easier for participants to reveal their preferences, the sorting continuum or grid usually takes the shape of a forced normal distribution (Webler et al., 2009). Participants' rankings of statements (Q-sorts) are analyzed by employing a by-person factor analysis to identify similar ranking patterns. This way, a larger number of variables is reduced to a limited number of factors, whereby each factor is interpreted as a shared viewpoint or perspective of the group of participants that significantly loads onto the factor (Alderson et al., 2018; Brown, 1980; Stephenson, 1993; Watts and Stenner, 2012).

3.1. Generation and selection of statements (Q-set design and Q-sample)

Our Q-study aims to discern areas of agreement and disagreement across different stakeholder groups on effective public health policies for large-scale mining operations in Burkina Faso. The set of statements (Q-set) utilized was developed based on an analysis of the perspectives and debated issues that relate to our topic of interest, *i.e.*, the 'concourse' in Q parlance (Brown, 1980; Watts and Stenner, 2005, 2012). The concourse analysis is based on a review of two main areas of study. Firstly, it reviews academic and 'grey' (policy) literature, focusing on the public health impacts of large-scale mining projects and the role of (health) impact assessments as regulatory tools. Secondly, it examines the literature on the political economy of large-scale mining in sub-Saharan Africa to understand the broader economic and political factors that influence the mining industry and regulatory practice in the region. By integrating insights from both areas, the concourse analysis provides a comprehensive understanding of the complex dynamics and consequences of large-scale mining projects on public health and its regulation in sub-Saharan Africa. It further builds on a review of the existing regulatory and institutional framework governing large-scale mining operations in Burkina Faso. This review was informed by six key informant interviews held in 2020 with public officials and selected civil society representatives with expert knowledge of mining sector governance and impact assessment practice in Burkina Faso.

Finally, our concourse analysis draws on 36 focus group discussions conducted in 2019 at three selected mining sites in Burkina Faso (Bagassi-Boromo, Houndé, Kongoussi) with local health service representatives as well as with representatives and members from affected communities (see Farnham et al., 2022; Leuenberger et al., 2021). Data gathered through focus group discussions, and key informant interviews also served to define the scope of the concourse and ensure adequate coverage of relevant topical themes and features (McKeown and Thomas, 2013; Webler et al., 2009).

Guided by the conceptual framework, the concourse was first analyzed regarding the policy content dimension and its three generic elements *situation assessment and risk analysis*, *public health management*, *monitoring and enforcement* (x-axis), and the two basic options for *regulation*. Rather than serving as rigid categories for quota sampling, these four elements served as pointers or topical themes indicating the issues that need to be included to have the content dimension sufficiently covered (Molenveld, 2020; Watts and Stenner, 2012). Initial statements were developed inductively from the analysis of the concourse and were further revised based on the matrix derived from the conceptual framework. For each topical theme, statements were developed reflecting different policy options regarding *scope*, *stringency*, *actors*, and *coordination*. This approach resembles the approach taken by Dryzek and Berejikian (1993) whereby initial statements and topical themes are developed inductively and then further organized along a deductively designed matrix (McKeown and Thomas, 2013; Molenveld, 2020).

On this basis, an initial Q-set of 234 statements was generated. From this a first sample of 40 statements was composed that was tested during a pilot study to ensure comprehensibility and sufficient topical coverage. Subsequently, a revised final sample (Q-sample) of n=40 Q-statements was generated (see Table 3 below).[1]

3.2. Selection of participants (P-set)

Study participants were purposefully selected based on their classification as representing policy stakeholders and based on whether they have a sufficient understanding of Burkina Faso's public health and mining regulatory framework, including concerning impact assessment. This was done to ensure Q-statements were comprehensible and meaningful to participants (Van Exel and De Graaf, 2005; Watts and Stenner, 2012). Ultimately, the selection of participants also sought to include participants with diverse backgrounds and professional roles to

[1] During data collection, statements were administered in French (see Appendix A, Table A.1).

Table 2
Stakeholder groups and selected participants.

Stakeholder groups		
Public sector ($P = 9$)	Private sector ($P = 5$)	Civil society ($P = 3$)
- Ministry of Mines and Quarries (*Ministère des Mines et Carrières*, MMC) ($P = 3$) - Ministry of Health and Public Hygiene (*Ministère de la Santé et de l'Hygènie Publique*, MoH) ($P = 3$) - Ministry of Environment, Green Economy and Climate Change (*Ministère de l'Environment de l'Economie Verte et du Changement Climatique*, MEVCC)[a] ($P = 3$)	- Industrial mining company I ($P = 1$) - Industrial mining company II ($P = 1$) - Chamber of Mines (*Chambre des Mines du Burkina*, CMB) ($P = 1$) - Private consultancy firm I ($P = 1$) - Private consultancy firm II ($P = 1$)	- Local civil society organization I ($P = 1$) - Local civil society organization II ($P = 1$) - Local representation of international development NGO ($P = 1$)
Multi-stakeholder organization ($P = 1$) - Local representation of the Extractive Industries Transparency Initiative (*Initiative pour la Transparence dans les Industries Extractives Burkina Faso*, ITIE-BF) ($P = 1$)		

[a] In 2022, the name was changed to *Ministère de l'Environnement, de l'Energie, de l'Eau et de l'Assainissement.*
Source: authors.

ensure a heterogeneous distribution (Nguyen et al., 2018; Tuokuu et al., 2019; Watts and Stenner, 2005). In total, a sample of 18 participants ($P = 18$) representing different government, private sector and civil society stakeholders was included, as listed in Table 2.[2]

3.3. Data collection (Q-sort administration and interviews)

Data were collected in the form of participants' sorted rankings of statements (Q-sorts), followed by brief complementary interviews. Selected participants were contacted prior to the study and informed about the background and motivation of the study. All participants were assured anonymity and admitted based on prior informed consent. Q-sorts and interview data were gathered during face-to-face sessions between June and July 2021.

For the Q-sort administration, participants were required to rank the 40 policy statements from the most to the least representative in accordance with their personal views. In the first step, participants were asked to read the statements carefully and sort the cards into three initial piles: most representative, least representative, and neutral. After that, participants were requested to sort all statements onto the distribution continuum (Q-sorting grid), from the most representative (+5) to the least representative (−5) to neutral (0) (Fig. 2). Participants were free to change their sorted rankings of statements until satisfied with the final distribution.

In the next step, we asked participants to explain their ranking choices, especially the statements ranked most representative (+5) and least representative (−5). These explanations helped with the factor interpretation and to gain a better understanding of stakeholder viewpoints and preferences. Subsequently, participants were asked about their general views on addressing public health effects in the context of large-scale mining operations. This question was designed as a broad and open question to allow participants to comment freely on the subject matter and to emphasize subjective points of interest and concern. The qualitative data were collected in the form of notes taken by the interviewer.

4. Factor analysis and results

A total of 18 Q-sorts found entrance into the analysis, reflecting the number of study participants. Factor analysis of Q-sort data was conducted through Principal Component Analysis (PCA), using the R software package (Zabala, 2014). Eight factors were initially extracted, and two were selected for rotation, employing a Varimax rotation method.

Several (statistical) criteria are discussed in the literature to guide factor selection, next to theoretical considerations. However, as there are no objective rules that determine the number of factors to be selected, factor selection remains an issue of subjective judgement (Brown, 1980; Molenveld, 2020; Nguyen et al., 2018; Watts and Stenner, 2012; Webler et al., 2009; Zabala et al., 2018). A two-factor solution was chosen based on theoretical significance (policy context and researcher background knowledge) as well as on the following statistical criteria whose application is generally considered good practice in Q-methodology: Kaiser-Guttmann criterion; the significant loading test; the minimum variance test (which specifies that factors should account for a minimum variance of >8% and a minimum cumulative variance of >30%); and the scree test (which clearly shows the slope levelling off after Factor 2) (Fig. 3) (see Armatas et al., 2014; Watts and Stenner, 2012).

Factor loadings of 0.41 or above were considered significant at the $p > 0.01$ level. Factor loadings indicate the relation between each participant's Q-sort and the factors (Zabala et al., 2018). Out of 18 Q-sorts, 15 loaded significantly on one of the two factors (nine on Factor 1, and six on Factor 2), with one being confounded, loading significantly on both factors, while two were null cases. Significantly loading Q-sorts were flagged for inclusion, and confounding Q-sorts were excluded (Watts and Stenner, 2012; Webler et al., 2009).

In the next step, factor *z* scores were calculated (see Table 3 below) and converted into factor arrays. The *z* scores reveal the relation between each item (*i.e.*, Q-statement) and the factors, indicating how each factor ranks each statement in comparison to all other study factors (Watts and Stenner, 2012; Zabala et al., 2018). Factor arrays were created through weighted averaging of included Q-sorts. Factor arrays represent a composite or 'idealized' Q-sort which stands for the

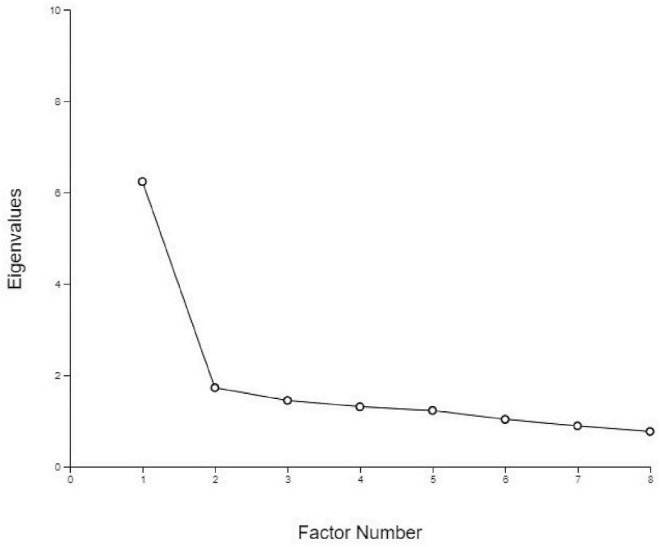

Fig. 3. Scree plot (source: authors).

[2] A full list of study participants (anonymized) is presented in Annex A, Table A.3.

Table 3
Q-scores and factor *z* scores for each item in the Q-sample.

No.	Q-statement	Factor 1		Factor 2	
		Q-score	*z score*	Q-score	*z score*
S1	The existing EIA are sufficient. No need for additional measures for public health.	−5	−1.92	−3	−1.4
S2	Mining companies shall decide on their own how they want to address public health issues.	−4	−1.65	−5	−2.21
S3	Requiring a separate HIA would overburden mining companies and deter investment.	−3	−0.97	−4	−1.73
S4	With the current EIA requirements, companies are free to include public health considerations where relevant. This is sufficient.	−3	−0.99	−3	−1.08
S5	EIA requirements need to be revised to include comprehensive consideration of public health.	+5	1.66	−1	−0.32
S6	Requiring a separate HIA would overburden the licensing authorities and create additional bureaucratic barriers.	−2	−0.68	−4	−1.67
S7	The government must require from mining companies a stand-alone HIA (in addition to the EIA) to mitigate adverse health impacts.	+4	1.46	−3	−0.75
S8	Mining licenses must not be granted or renewed without a "public health management plan".	−4	−0.99	+5	1.58
S9	Build up technical capacity in the MEEVCC to assess the quality of public health aspects in EIAs.	0		0	
S10	Build up technical capacity in the MoH to assess the quality of public health aspects in impact assessments.	+2	0.88	+2	0.77
S11	Baseline data on health indicators must be collected to assess the health impacts of mining projects.	+5	1.73	+5	1.69
S12	The MoH must provide companies with clear methodological guidelines for conducting HIA.	+2	0.63	+2	0.78
S13	Monitoring and technical staff must have protected tenure to prevent political appointments and shield regulatory institutions from political interference.	−1	−0.29	−1	−0.09
S14	A separate department needs to be created within the MoH to monitor the health impacts of large-scale mining projects.	+1	0.62	+2	0.55
S15	Mining companies can voluntarily disclose information on health impacts to local communities.	0	−0.16	−4	−1.73
S16	The MoH requires more financial resources to monitor public health management of mining companies.	0	0.07	−1	−0.06
S17	The MoH must publicly disclose annually the results from public health monitoring in mining areas.	+3	1.19	+2	0.59
S18	Only regular audits and inspections by public officials can ensure that mining companies adhere to public health protection measures.	−2	−0.76	+1	0.55
S19	The government must amend mining regulations to strengthen the monitoring of mining companies' health performance.	0	−0.02	−2	−0.41
S20	Monitoring of public health impacts should be left to mining companies which can publish annual monitoring reports.	−5	−2.22	−5	−2.2
S21	Capacity to conduct smaller public health monitoring should be build up at district level and within regional administrations.	−1	−0.3	+1	0.47
S22	The MoH needs to be directly involved in regular mining-site inspections and the measurement of pollutants.	+1	0.57	+4	1.09
S23	The government must establish a clear sanctions framework to penalize non-compliance with public health regulations and standards.	+4	1.46	+3	0.84
S24	When mining projects are decommissioned, mining companies must present rehabilitation plans that include targeted measures that address public health.	+4	1.26	0	0.06
S25	Create a formalized forum for stakeholders from government, civil society, academia, and the private sector to ensure continuous discussion of health challenges related to mining.	+1	0.17	+1	0.47
S26	Establish a centre of expertise at a university or research institution to train civil servants in HIA.	−1	−0.64	0	0.05
S27	Coordination between actors responsible for issuing licenses, and those responsible for monitoring must be greatly intensified.	0	0.06	−1	−0.3
S28	The MoH must have a formal role in the licensing process to ensure the inclusion of HIA in current EIA.	+1	0.12	0	0.39
S29	The MoH must publish its technical advice on impact assessments to avoid being disregarded during the final decision-making process.	+2	0.73	0	0.25
S30	Strengthen the technical commission in which all actors responsible for issuing licenses coordinate (health, environment etc.) so that their findings cannot be overruled.	−1	−0.48	−1	−0.08
S31	At the beginning of each impact assessment, companies must carry out consultations on health issues with local health professionals, women and civil society groups, and communities.	−1	−0.65	+4	1.43
S32	Companies must share the results of their HIA in a simplified format to make it intelligible for ordinary citizens and illiterate community members.	0	0.12	+4	1.12
S33	The government is responsible to invest in public health services in mining areas to provide equipment, medicines, and training for health personnel.	+3	1.14	−2	−0.75
S34	The government must establish a platform for coordination between the local health system and mining companies to ensure that voluntary health projects of companies benefit local communities.	+2	1.09	+3	0.97
S35	Mining companies should be encouraged to communicate an annual application window for corporate social responsibility projects so that health system actors can submit proposals.	+1	0.14	+1	0.45
S36	Mining companies shall be required to finance regular health monitoring surveys in mining areas.	−3	−0.85	+3	0.85
S37	Mining companies shall be obliged to conduct regular awareness campaigns on (mining related) health risks and promote best health practices.	−2	−0.8	−2	−0.42
S38	Mining companies must be obliged to finance goods and equipment to local health services, including ambulances and a medical laboratory for health testing.	−4	−1.02	+1	0.43
S39	Mining companies shall be required to run a health facility open to the public.	−2	−0.76	−2	−0.52
S40	Mining companies should publicly communicate their responses to (health-related) grievances and complaints.	+3	1.2	0	0.17

Source: authors.

perspective associated with a particular factor (Van Exel and de Graaf, 2005; Watts and Stenner, 2012).

Together, the two selected factors explain 45% of the study variance. Correlation between factors scores is insignificant at the $p>0.01$ level. Factor 1 explains 35% of the study variance, and Factor 2 10%. The Q-sorts of nine study participants are significantly associated with Factor 1 (and with Factor 1 only) at the $p>0.01$ level. The Q-sorts of six study participants are significantly associated with Factor 2 (and with Factor 2 only) at the $p>0.01$ level.[3] Table 3 shows composite Q-sort ranking scores (Q-scores) and factor *z* scores for each statement in the Q-sample.

5. Interpretation

Individual Q-sorts, as well as the two factors representing broader stakeholder perspectives, reveal an overarching consensus on the need to strengthen public health considerations in large-scale mining projects in Burkina Faso. Examination of all 18 Q-sorts indicates a widely shared view that the current regulatory framework does not sufficiently address adverse health impacts caused by large-scale mining projects. Out of 18 study participants, 15 gave (saliently) negative ratings to statement S1: "The existing EIA are sufficient. No need for additional measures for public health"; only one participant gave it a neural (0) and two the lowest positive ranking (+1).

Study participants unanimously reject the proposal that monitoring of public health impacts should be left to mining companies (S20). At the

[3] Further factor characteristics are reported in Appendix A, Table A. 2.

same time, a near-unanimous (17 out of 18) consensus exists that mining companies should not decide how to address public health (S2). All statements that favour the *status quo* (S1, S4) or propose leaving the management of public health impacts at the discretion of mining companies (S2, S20) have, on average, received saliently negative rankings. Furthermore, 17 out of 18 study participants reject the view that requiring a mandatory, stand-alone HIA would either overburden mining companies and deter investment (S3) or overburden licensing authorities and create additional bureaucratic barriers (S6).

Analysis of individual Q-sorts thus points to a far-reaching consensus among stakeholder representatives on the inadequacy of existing regulation of health impacts. Ranking choices also indicate a clear rejection of industry self-regulation and a broad agreement on the feasibility of introducing HIA as a regulatory instrument. While these general findings indicate broad support for policy change and progressive public health policy development, interpretation of the two identified perspectives reveals disparate focal points and emphasis on different policy options.

5.1. Perspective 1: top-down governance and state-centred regulatory reform

Interpreting factor z scores and idealized Q-sorts for Factor 1 in conjunction with qualitative interview data reveals a perspective that puts the state in the spotlight as the key actor responsible for mining sector governance and regulating associated health impacts.

Under this perspective, the state is seen as the principal regulator and main actor responsible for addressing public health impacts from large-scale mining projects. This principled view is neatly encapsulated by a representative of a local civil society organization (CSO) who opined that "the government in charge is the guarantor of human rights, including the safety of its population. Therefore, it is the government that must ensure the right to health of communities living near mining facilities in Burkina Faso" (BF06-02). In the same vein, a Ministry of Health (MoH) official noted, "the state must be the guarantor of control of health impacts by the mines" (BF02-01).[4]

Reflecting the consensus that the existing environmental and social impact assessment (ESIA) framework is insufficient, *Perspective 1* prioritizes legal and regulatory reforms. As noted by a senior official from the Ministry of Mines and Quarries (MMC), "there is a great need [for additional measures]. ESIAs are not sufficient", stressing that without legal guidelines, the management of health impacts was left to voluntary measures by mining companies: "it is necessary to reinforce the existing legislation; otherwise it is a question of CSR [corporate social responsibility], a voluntary contribution not supervised by the state" (BF01-02). Similarly, the director of a local consultancy firm pointed to "shortcomings" in the current ESIA framework while emphasizing a "lack of clarity on public health" (BF05-01).

Notable support for legal and regulatory change is also reflected in the endorsement of HIA as a regulatory tool: both a revision of existing EIA requirements to include comprehensive considerations of public health (S5) and introduction of a mandatory, stand-alone HIA (S7) receive strong support under *Perspective 1*. In theory, both policy options represent distinct approaches to including public health considerations in impact assessment practice. High z scores for both options can be interpreted in two ways: firstly, despite agreeing on the need to integrate public health into the regulatory framework, there is underlying disagreement regarding the right approach. Secondly, it is also possible that stakeholders have not (yet) developed a clear preference for one approach over the other, embracing both policy options as a step in the right direction. Analysis of individual Q-sorts loading significantly on Factor 1 points towards the latter interpretation as individual ranking choices do not indicate a decisive pattern in favour of one approach: six out of nine Q-sorts have ranked both options positively and in proximity. While the remaining three suggest a clearer preference (for one or the other), it needs to be emphasized that the only negative ranking is at a low −1 (for stand-alone HIA, S7), which does not suggest strong opposition. Thus, *Perspective 1* can tentatively be interpreted as supporting both options of including HIA into the current regulatory framework. Nevertheless, this tentative interpretation does not rule out that individual or institutional disagreements over the best approach exist or could become more accentuated in the future.

Reflecting the widely shared view that public health impact monitoring must not be left to mining companies, *Perspective 1* views the collection of baseline data on health indicators (S11) as a key measure to define objective standards and enable better monitoring. As a senior MMC official stressed, "you have to set standards: that's the basis of judgment" (BF01-02). This indicates a robust consensus under which identification of key health determinants, baseline assessments, benchmark setting, and health impact monitoring are viewed as key elements to evaluate the performance of mining companies.

In line with the endorsement of better monitoring, the proposal that MoH must publicly disclose annually the results from public health monitoring in mining areas (S17) finds considerable support. A local representative of an international development NGO argued that regular publication of public health data was the duty of MoH as "populations, particularly the communities living near mining projects, have the right to information on health issues related to negative externalities of mining. Also, disclosure of health information allows communities to prepare for future extensions of mining projects" (BF06-02). Similarly, a representative of a private consultancy firm contended that "communities need and are entitled to have this health information. It is extremely important for the community" (BF05-02). Giving the MoH a role in regular reporting is thus seen as an important measure to increase transparency on mining-related public health impacts.

Calls for improved baseline assessments, benchmark setting, monitoring and compliance enforcement are complemented by strong support for establishing a corresponding sanctions framework (S23). Under *Perspective 1*, sanctions are regarded as an indispensable coercive tool to ensure mining companies' compliance with public health provisions. In part, strong support for sanctions appears to be stemming from the perception that mining companies can easily defy state regulations and are not sufficiently deterred by the existing sanctions framework. An MMC official claimed that "dissuasive sanctions are needed because industrial mines are breaking the law" (BF01-01). The official further asserted that the existing sanctions framework was often toothless: "I believe that there is a problem with clarifying the sanctions, particularly in the area of health, because, for example, the infraction of not watering the roads used by mining vehicles is not sanctioned. The current sanctions foresee the withdrawal of the exploitation permit, which seems to me difficult to withdraw. So I propose monetary sanctions because industrialists do not want to lose money." Correspondingly, another senior MMC official posited that "until there are clear rules, it is difficult [for companies] to respect public health. […] The mining companies are not going to sanction themselves" (BF01-02). The director of a local consultancy firm further argued that establishing a targeted sanctions framework would send an important signal that the government takes public health transgressions seriously (BF05-01).

The importance of state agency as a defining characteristic of *Perspective 1* is further illustrated by the shared view that it is the government's responsibility to invest in public health services in mining areas (S33) rather than that of mining companies. "The mines pay taxes to the state. So, it is the state's responsibility to provide health services" (local CSO representative, BF06-01). Correspondingly, proposals that mining companies must be obliged to finance goods and equipment for local health services (S38) or shall be required to run a health facility open to the public (S39) are generally opposed under this perspective. As noted by a senior MMC official: "the industrialists do not replace the state of Burkina. It is up to the state to better define its health concerns and to manage them with the taxes generated by the mines." In the same

[4] BF02-01 was excluded from factor analysis due to being a null case.

vein, a representative of a local CSO argued that "this [public health service provision] is the classic sovereign role of the state. The mining company does not replace the state and should not replace it" (BF01-01).

Similarly, under *Perspective 1*, proposals that would require mining companies to finance regular health monitoring surveys in mining areas (S36) or to conduct regular awareness campaigns on (mining-related) health risks (S37) tend to be dismissed. As noted by an official from the Ministry of Environment (MEVCC): "mining companies can provide support, but that is not their role. That is the role of the state and civil society organizations" (BF03-01).

It follows that, under *Perspective 1*, the state is considered the principal actor responsible for impact monitoring, public health service provision and public health information. However, taking into account individual comments by participants loading significantly on Factor 1, it is important to provide some nuance to this interpretation. As a senior MMC official (BF01-02) pointed out: "mining companies can be a financial supporter and technical partner (providing equipment, training, etc.)", arguing that "the presence of the mining companies should be used to strengthen the health system at the regional level, particularly because their health centers are efficient." In the same vein, another senior MMC official (BF01-01) suggested that "mining companies may contribute financially, but the state is ultimately responsible." These comments illustrate that proponents of *Perspective 1* are not principally opposed to financial or other contributions by mining companies, for example, in the context of CSR, but are adamant that the principal agency and responsibility for public health service provision, monitoring, and information must lie with the state.

In contrast, the rehabilitation of mining sites is considered a company obligation whereby mining companies should be required to present rehabilitation plans that include targeted measures addressing public health (S24). "At [mine] closure, environmental and health liabilities must be managed. Some problems may be triggered in 20 years, and rehabilitation must take this into account. Otherwise, there will be endless health problems in the [mining] area, especially since the population tends to move back into the area, and problems are triggered later" (BF03-01, senior MVECC official). Public health-sensitive rehabilitation of mining sites is thus regarded as a measure to ensure long-term control of adverse health impacts.

Overall, the interpretation of Factor 1 and corresponding qualitative data indicates that proponents of *Perspective 1* tend to reject the transfer of tasks considered fundamental public duties to mining companies (and *vice versa*), blurring areas of state and private sector responsibility. *Perspective 1* is thus favouring a clear division between private and public sector responsibilities, rejecting hybrid public-private governance models in public health and what is perceived as abdication of core state responsibilities.

The analysis does not associate *Perspective 1* with particular stakeholders or stakeholder groups. Representatives from four stakeholder groups load significantly on this perspective. Hence, *Perspective 1* is reflective of a cross-cutting view that includes representatives from the MMC, MEVCC, the private sector, civil society organizations and EITI Burkina Faso. However, it needs to be emphasized that not all policy proposals ranked highly under *Perspective 1* are equally endorsed by all participants loading significantly on Factor 1. Moreover, no representative from MoH and only one out of three representatives from the MEVCC load significantly on Factor 1. Consequently, *Perspective 1* is not (equally) defined by all stakeholder groups.

5.2. Perspective 2: emphasis on coordination and inclusion

Analysis of Factor 2 reveals a perspective that equally endorses regulatory reform, improved monitoring and compliance enforcement but places greater emphasis on consulting and coordinating with local communities and on the responsibilities of mining companies in addressing public health.

Baseline data collection on health indicators (S11) is equally endorsed under *Perspective 2*. Gathering baseline data is also seen as a tool to address prevalent uncertainties on the health impacts of mines and to make better use of existing information: "there is enough speculation and information on health problems in almost all of the mines in operation in Burkina. Therefore, it is important to have a study that allows us to define health indicators in a mining context that we can report on regularly" (high-ranking MMC official, BF01-03). Correspondingly, an MoH official noted that "definition of indicators seems important insofar as they allow monitoring and control of health or the impact of mining activity in our country" (BF02-02).

Perspective 2 regards a public health management plan (S8) a key policy measure to address negative public health impacts. As a representative of a private consultancy firm explains,

> in Burkina Faso, there are environmental and social management plans before [project implementation], and feasibility studies. However, I must say that there is no follow-up. Also, in my opinion, the health issue is not specifically taken into account. […] We believe that any mining operation or project should have a health management plan in place prior to obtaining a mining permit (BF05-02).

A representative of an industrial mining company further highlighted the importance of a management plan to determine company action:

> It is always at the time of the ESIA that everything comes together because that is when everyone is consulted. This is when everything can be improved, and the mining companies can be forced. In particular, there is work with the professionals, especially in the commissions. […] The management plan is an indispensable initial document that is submitted to the [licensing] committee. […] This plan states everything that is done during the life of the project until the closure of the mine (BF04-01).

Moreover, there is a shared view that, at the beginning of each impact assessment, mining companies must carry out consultations on health issues with local health professionals, women and civil society groups, and affected communities (S31). Such consultations are considered a critical instrument already part of the ESIA process but missing for public health. Congruently, a MEVCC official notes that prior consultations would "allow us to know the types of health problems and if there is an intensification of problems to identify them to guide future action" (BF03-03). Carrying out local consultations on health issues during impact assessment is thus regarded as a crucial measure to address public health risks.

The direct involvement of MoH in regular mining-site inspections and measurement of pollutants (S22) is viewed as a necessary measure to ensure effective monitoring and prevention: "because health concerns are not imperative to mining companies. The state and the Ministry of Health must get involved" (BF01-03). Similarly, an MEVCC official contends that "the Ministry of Health only comes when the mine invites them. If a department is established, this will allow regular visits and inspections" (BF03-02). A stronger role for MoH in public health monitoring was also endorsed by an MoH official who concurred that "the Ministry of Health must be involved in the chain, especially in periodic evaluation of the health of the communities living near the mine" (BF02-03). In the same vein, a representative of a large-scale mining company argued that "the Ministry of Health must do impact monitoring. Mining companies cannot be judge and jury. Even if they have internal monitoring tools, monitoring must be external" (BF04-01).

Study participants defining *Perspective 2* also welcome the proposal that mining companies must share assessment results in a format intelligible for ordinary citizens and illiterate community members (S32). An MEVCC official stressed that current "ESIAs are not understood by local residents, including what concerns compensation. Moreover, some officials do not want to make them understandable. Therefore, a better understanding of the ESIAs would avoid worries and promote social peace." The representative of a large-scale mining company concurred

that enhanced transparency of impact assessment was advisable, stressing that "this is the minimum. The information must be passed on to civil society, to communities about the project and its impact. We can't hide it" (BF04-01). These results indicate that *Perspective 2* is not only concerned with better public health monitoring and impact assessment as technical measures but also emphasizes transparency and more inclusive communication: "if results are made public, it will help guide research and action" (MEVCC official, BF03-02). In addition, better coordination between the public health sector and both mining companies and relevant public institutions is advocated. As indicated above, specifically, the lack of engagement and coordination by MoH is seen as a major gap:

> We believe that the Ministry of Health must be able to integrate mining health concerns into its strategic plan and make a connection with the health concerns developed by the mines. That is to say, there must be coordination or collaboration in health between the mine health system and the state health system (MMC official, BF01-03).

This and similar views also resonate with strong support for the requirement of a public health management plan.

Demands for enhanced consultation and coordination between mining companies on the one hand and local communities and the public health sector on the other illustrate a more actor-oriented view that emphasizes the need for on-the-ground solutions. In this regard, proponents of *Perspective 2* appear more open to hybrid arrangements in service provision and financing. Comments made by an MEVCC official illustrate this view:

> The exploitation of the mine makes a lot of money while the population needs support: CSR must be taken into account. The totality of the dividends paid to the state does not allow for investment in these areas. This will also help build trust between the population and the mine. […] Mining companies must set up these [public health] infrastructures and equip them. Setting up health centers means equipping them (BF03-03).

Tapping on the financial resources of mining companies is seen as necessary to ensure funding of public-health-related infrastructures and initiatives. However, a company representative also took a critical view on the current allocation of funds that mining companies provide to the Local Development Mining Fund: "the chairmen do what they want with the Mining Fund. There is no definition of a sustainable project; there are no quotas such as x% for health, x% for education, etc. Amendments are needed; otherwise money is squandered" (BF04-01). These comments illustrate a greater focus on localized, practical (financing) solutions under *Perspective 2*.

Overall, *Perspective 2* illustrates a view that equally endorses regulatory reform, improved monitoring and compliance enforcement, but embraces further policy demands specifically directed at mining companies and their interaction with local communities and the public health sector. The distribution of responsibilities between private and public sector actors appears to be less of a concern than questions regarding effective policy implementation.

Despite these differences in focus, the interpretation of Factor 2 and corresponding qualitative data does not indicate that *Perspective 2* is fundamentally different from *Perspective 1*. Both perspectives can be interpreted as variations of the overarching consensus on the need to strengthen public health considerations in the context of large-scale mining projects in Burkina Faso.

Also *Perspective 2* cannot clearly be associated with a particular stakeholder or stakeholder group. Representatives from four stakeholder groups (MEVCC, MMC, MoH, private sector, CSOs) load significantly on this perspective, indicating a cross-cutting view. However, it needs to be pointed out that *Perspective 2* has been particularly defined by representatives from MEVCC and MoH as two out of three study participants from these two institutional stakeholders load highly on Factor 2.

5.3. Stakeholder positions: areas of consensus and dissent

To answer the guiding questions raised above, we discuss to what extent the two identified perspectives reveal stakeholder positions on policy action. Building on the conceptual framework, we point out shared and diverging positions (Table 4) while giving room to individual viewpoints and critical voices.

Our analysis makes clear that study participants from all stakeholder groups see a need for policy action to address adverse public health impacts in industrial mining areas. There is a robust consensus that the *status quo* is intolerable and that industry self-regulation is undesirable. This is also illustrated by a comparison of the top five least representative statements under *Perspective 1* and *Perspective 2* (Fig. 4). This overarching consensus holds across all stakeholder groups. Moreover, under both perspectives, stakeholders chiefly agree that it is primarily the government's responsibility to strengthen public health considerations in impact assessment, while there is a widely shared expectation that MoH should take the lead in driving a policy reform process. With regard to policy measures, stakeholders agree on the need to carry out sound situation assessments and mandatory risk analyses as well as to strengthen monitoring and enforcement efforts. While stakeholders embrace greater monitoring by the government and MoH in particular (Fig. 5), critical voices also stress "the need for civil society to monitor the situation" (MoH official, BF02-01). Some see involving independent NGOs as watchdogs. as a necessary safeguard to ensure that monitoring is conducted in a professional and impartial manner, as "government officials are too dependent on mining companies to be effective" (BF03-01).

A comparison of factor z scores further indicates broad agreement across stakeholder groups for a clear sanctions framework to penalize non-compliance among mining companies (Fig. 5). However, it needs to be pointed out that the two participating mining company representatives have given this policy proposal only low positive rankings (+1 and + 2), suggesting that support for sanctions is not as pronounced among mining companies. Broad support for sanctions resonates with comments indicating a general lack of public trust in mining companies' commitment to safeguarding public health. As noted by a local NGO representative, "the mining companies do not prioritize the management of health problems caused by them but are rather preoccupied with making the maximum profit" (BF06-02). This view was also held by a high-ranking MMC official: "industrial mines are only concerned with making a profit and minimizing expenses, so health issues are minor concerns" (BF01-03). An MoH official who called for "clear and applied" sanctions further alleged that "mining companies hide information on the real health record of their operations to preserve their image" while stressing that "we record a significant number of health violations by industrial mines" (BF02-01). Hence, shared demands for enhanced monitoring and sanctions also come against the negative perception of companies' past organizational behaviour. Consistently, an MEVCC official attested "a crisis of confidence" (BF03-02) with regard to mining companies' activities.

In the field of health management and regulation, stakeholders emphasize different policy options, revealing potential points of disagreement. The introduction of a public health management plan is not endorsed under *Perspective 1*, suggesting disagreement or diverging priorities among stakeholders. An examination of individual Q-sorts indicates polarized ranking choices among study participants and stakeholder groups: two out of three officials from the MMC provided saliently negative (−5, −4), and representatives from the MoH consistently positive rankings (+4,+4,+3). Similarly, representatives from mining companies and local consultancy firms exhibit polarized ranking choices (+5, −3 and +5, −4, respectively), suggesting dividedness over the need to make a public health management plan a mandatory licensing requirement.

Under both perspectives, stakeholders see the need for regulatory reform; however, there are diverging preferences as regards the best

approach to include public health considerations into impact assessment practice. As outlined above, under *Perspective 1*, both a revision of existing EIA requirements as well as introduction of a stand-alone HIA receives support. In contrast, *Perspective 2* clearly favours a revision of existing EIA requirements to integrate public health provisions into the existing framework, dismissing proposals to establish a separate, stand-alone HIA (Fig. 4, S7). Thus, while the inclusion of HIA provisions into current impact assessment practice is widely supported, not all stakeholders see the need for establishing a separate, full-fledged HIA.

As not all Q-statements receive high Q-scores, the two identified perspectives do not cover all policy proposals included in the Q-sample. One particular policy issue that has not been salient among the two identified perspectives but features prominently in qualitative interview data concerns capacity-building measures. Despite receiving low Q-scores under *Perspective 1* and *2*, several stakeholder representatives consider capacity-building an important policy measure as illustrated by individual ranking choices: four out of 18 study participants gave the proposal to build up technical capacity within MoH (S10) the highest possible ranking (+5). This proposal is consistently ranked above the proposal to build up technical capacity within MEVCC (S9) or at the district level and within regional administrations (S21). Support for capacity-building within MoH further reflects stakeholders' shared support for greater involvement of the MoH in public health monitoring. Correspondingly, a mining company representative stressed that the "capacities of health actors involved in monitoring and environmental studies need to be strengthened" (BF04-02). Similarly, the representative of a local consultancy firm reported that health professionals participating in the inter-ministerial Technical Committee for Environmental Assessments (*Comité Technique sur les Évaluations Environnementales*, COTEVE) "complain" that they lack the technical capacity to analyze the situation, arguing that "their capacities must be strengthened and they must be trained" (BF05-01). This suggests that capacity-building measures - rather than being dismissed as irrelevant - are eclipsed by priority issues.

Different institutional stakeholders were also mentioned as important political facilitators. According to a high-ranking MMC official, the "Ministry of Health must take the initiative and coordinate the issue of health in mining projects with other ministries" (BF01-03). Similarly, an MEVCC official concurred that "we need commitment from the Ministry of Health to propose something" (BF03-03).

Overall, stakeholder representatives clearly stress political mobilization and high-level political commitment as a crucial precondition for

Table 4
Schematic overview of key policy preferences revealed by stakeholder perspectives; (empty cells show areas where *Perspective 1* and *2* do not clearly indicate stakeholder preferences).

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">Content: What should be the focus of public health policy?</td><td colspan="2">Regulation: How should public health be included in the legal framework?</td></tr>
<tr><td>Situation assessment and risk analysis: Determinants, data to be collected, impacts on health outcomes, severity, probability</td><td>Health management: Project design, prevention, service provision, mine closure</td><td>Monitoring and enforcement: indicators, public health outcomes, compliance</td><td>Integrated approach: Build on and expand existing legislation for licensing and EIA</td><td>Stand-alone approach: Introduce separate legislation for HIA</td></tr>
<tr><td rowspan="5">Properties that define each content element</td><td>Scope: What should be covered?</td><td rowspan="2">Shared emphasis on sound situation assessment and (baseline) data collection and mandatory risk analysis</td><td>Perspective 1: Focus on mine site rehabilitation</td><td rowspan="2">Shared emphasis on monitoring</td><td rowspan="4">Shared support for inclusion of public health considerations into existing ESIA</td><td rowspan="4">Perspective 1: Require companies to conduct a full-fledged HIA</td></tr>
<tr><td>Stringency: How mandatory should policies be?</td><td>Perspective 2: Central role of a comprehensive health management plan</td></tr>
<tr><td>Actors: Who should be responsible for different measures and targeted by regulation?</td><td colspan="3">Perspective 1: Strong role for the government in defining the process from situation assessment and risk analysis to monitoring and enforcement, including in health service provision</td></tr>
<tr><td>Coordination: How should actors across institutions and sectors coordinate, and who should be included in decision-making?</td><td colspan="2">Perspective 1: Increased transparency for local communities on health impacts and annual publication of monitoring results</td></tr>
<tr><td colspan="3">Perspective 2: Emphasis on consultation with local stakeholders, coordination within the public sector and with mining companies, sharing of assessment results</td></tr>
</table>

Source: authors.

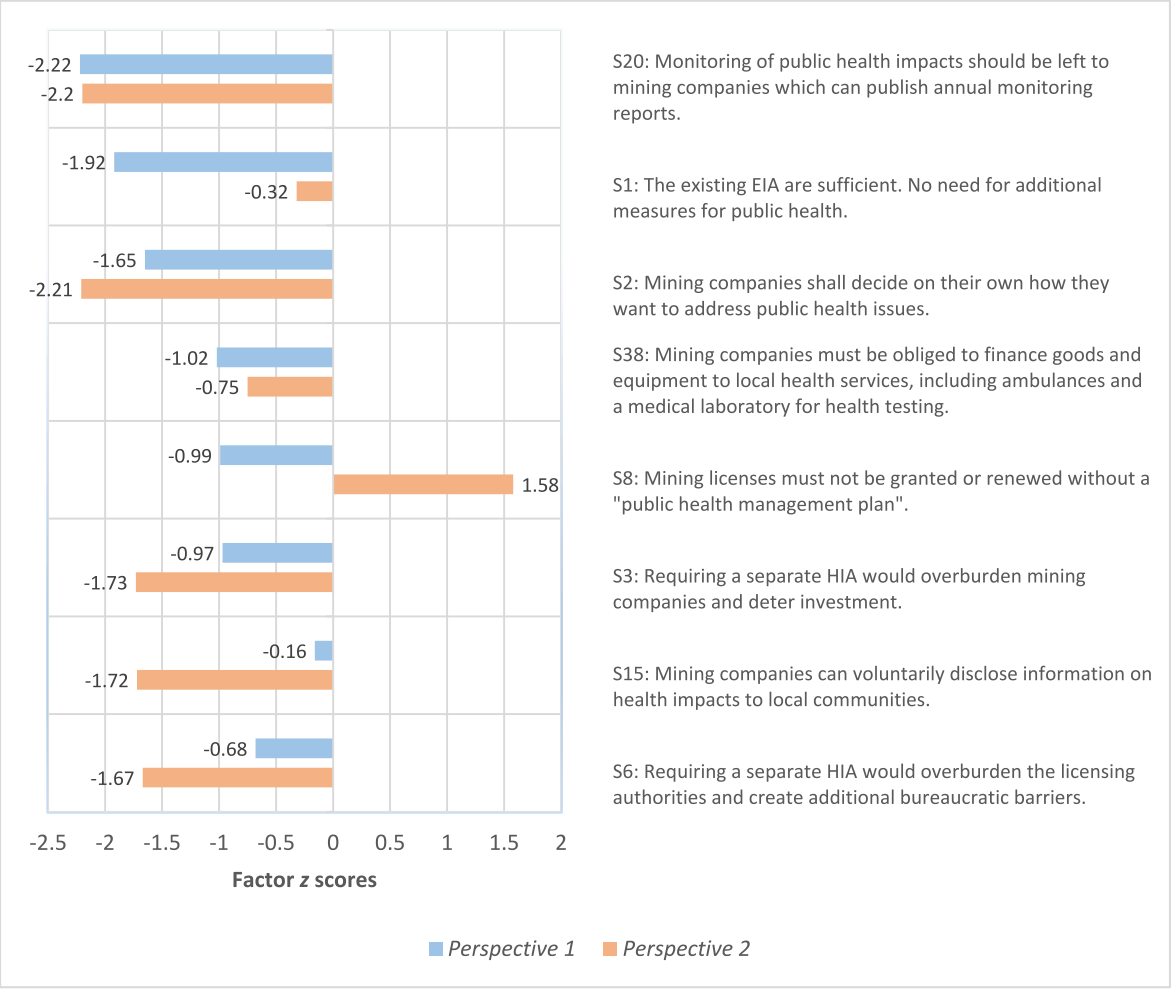

Fig. 4. Least representative statements of *Perspective 1* and *2* (top five); source: authors.

progressive health policy development rather than bridging diverging preferences among different stakeholders. This is consistent with the identified overarching consensus on the need to strengthen public health considerations in large-scale mining projects in Burkina Faso.

6. Discussion and conclusion

Recent studies have underscored the dual impact potential of large-scale mining projects on public health. While positive and negative effects are possible, the absence of health risk assessments, health management plans and monitoring tends to exacerbate negative health outcomes (Knoblauch et al., 2018; Leuenberger et al., 2019; Shiquan et al., 2022). This holds particular relevance in Africa, where the absence of comprehensive regulation often leads to insufficient health considerations in impact assessments (Dietler et al., 2020; Engebretsen and Brugger, 2021). Initial findings from cases like Zambia's Trident copper mine, where comprehensive HIAs were implemented, indicate positive health outcomes (Farnham et al., 2022; Knoblauch et al., 2018).

Both academic literature and multilateral development institutions, including the World Health Organization (WHO), the Asian Development Bank (ADB), and the World Bank's International Finance Corporation (IFC), advocate for HIA (ADB, 2018; IFC, 2009; WHO, 2023). Yet, a gap remains in understanding local attitudes toward progressive health regulations in mining and the political will for embracing HIA.

Taking the case of Burkina Faso, our Q-methodology study aimed to explore the available policy space for regulating public health in large-scale mining and to shed light on the policy preferences of stakeholders from government, the private sector, and civil society. At the conceptual level, we provide a framework that draws on the concept of HIA to map the policy preferences held by different stakeholder representatives. As this framework is generic, it can be applied across different settings to guide policy research and development in the field of regulating public health in resource extraction projects. At the research level, we demonstrate the use of Q-methodology for conducting policy studies and identifying policy preferences of different stakeholders and areas of consensus and dissent. At the policy level, the results of this study provide the basis for initiating a policy dialogue by identifying likely barriers and levers for policy reform, providing guidance for policymakers.

6.1. Key findings

We find that representatives from all included stakeholder groups agree on the need to strengthen public health considerations in large-scale mining projects in Burkina Faso. Two broader stakeholder perspectives emerged, highlighting a shared belief in the inadequacy of current health regulations in mining projects and the demand for

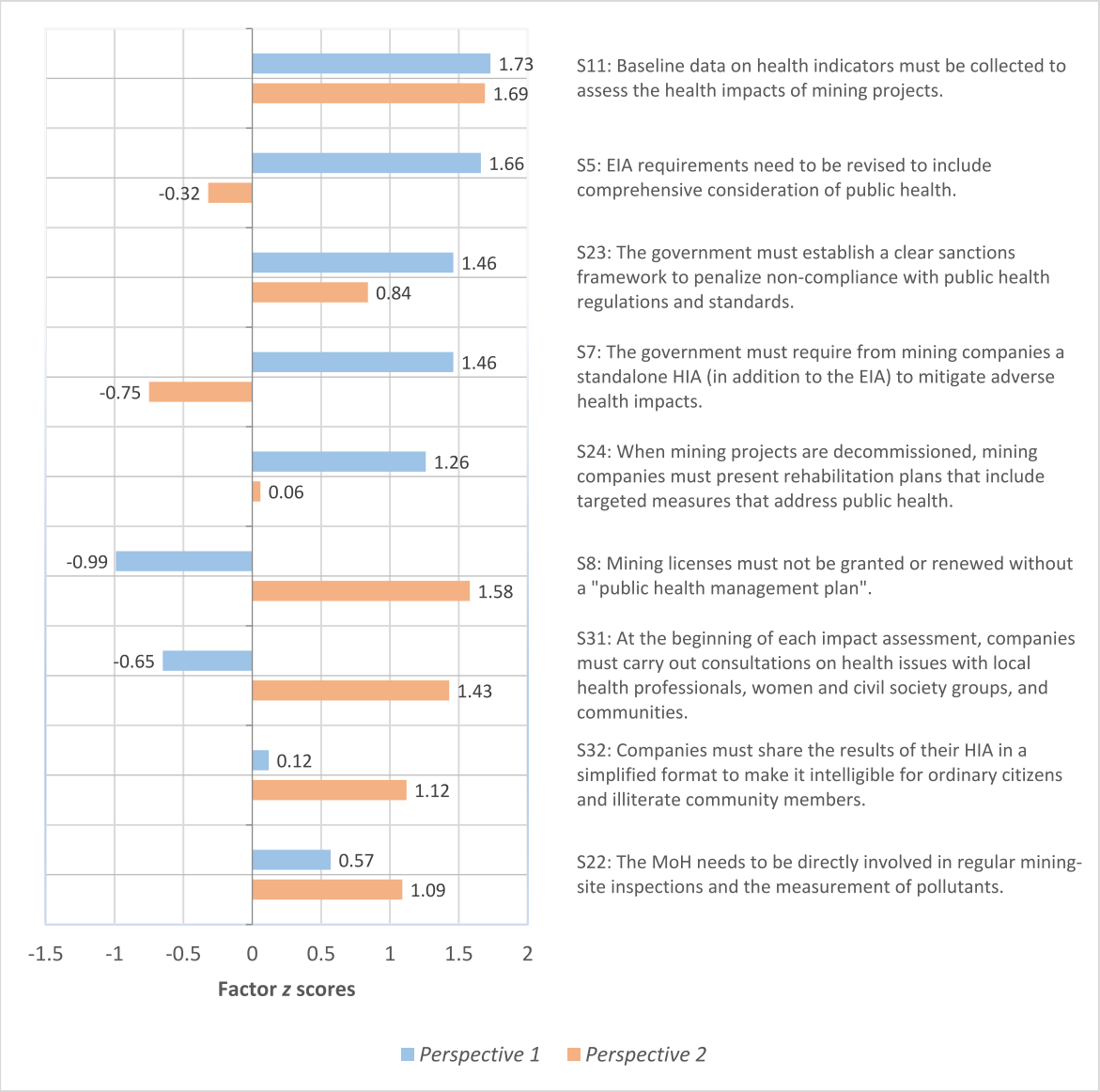

Fig. 5. Most representative statements of *Perspective 1* and 2 (top five); source: authors.

regulatory reforms. This consensus spans government agencies, civil society, and mining industry representatives. Consequently, policy initiatives for strengthening public health in impact assessment practice can be expected to build on broad-based support across relevant stakeholder groups. Thus, in answer to our first two research questions, our findings suggest that local stakeholders clearly see a need for policy action and support regulatory change to strengthen health considerations in industrial mining.

The analysis of stakeholder preferences also offers insights into specific policy directions that stakeholders favour as well as regarding allocation of accountability, addressing research questions three and four. The two identified perspectives strongly oppose industry self-regulation and show a widespread consensus to incorporate HIA as a regulatory tool. *Perspective 1* positions the state as the principal regulator and the main actor responsible for overseeing public health impacts in large-scale mining projects. This perspective highlights the government's pivotal role in outlining the entire process – from situational assessment and risk analysis to public health management, including healthcare services. Equally, *Perspective 2* advocates for regulatory reform, enhanced monitoring, and strict compliance enforcement but emphasizes engagement with local stakeholders and coordinated efforts among mining companies and the public sector. A key point is the requirement for companies to submit a public health management plan as a condition for obtaining licenses, recognized as a crucial policy measure to mitigate adverse public health impacts. As both perspectives are defined by representatives from different stakeholder groups, the views expressed are cross-cutting, suggesting that they transcend the predefined groups included in the study (cf. Molenveld, 2020).

6.2. Policy-making implications

The findings of this study carry significant policy-making implications. First and foremost, the clear rejection of industry self-regulation and the consensus favouring the introduction HIA as a regulatory instrument underscore the need for more robust oversight and evaluation of public health considerations in large-scale mining projects. This points to necessity of strong government involvement, with the MoH driving policy reforms in cooperation with other regulatory bodies.

The differing emphases of *Perspective 1*, focusing on governmental regulation, and *Perspective 2*, highlighting stakeholder consultation and coordination, necessitate a nuanced policy approach. Policymakers should aim to balance central governmental authority while also

engaging local health sectors, affected communities, and industry players at extraction sites. A robust policy measure, endorsed under *Perspective 2*, is requiring mining companies to submit public health management plans for licensing. This can effectively address adverse public health impacts and potentially serve as a cornerstone for policy reform, ensuring mining projects adhere to stringent health considerations. However, recognizing the diverse stakeholder preferences is important. With some stakeholders strongly advocating for the mandatory public health management plan and others expressing opposition, striking a balance in regulatory stringency may be necessary. Policy guidelines could facilitate tailored strategies, possibly allowing flexibility in plan implementation while ensuring it tackles critical health impacts.

6.3. Limitations

It is important to acknowledge the limitations when interpreting and utilizing Q-study findings for progressive policy development. First, it is essential to recognize that Q-methodology is not designed to produce generalizable findings for an entire (stakeholder) population, as in a representative survey (Watts and Stenner, 2005; Webler et al., 2009). Instead, it provides an overview of pertinent perspectives, unveiling both shared and divergent viewpoints among participants. While highly relevant for understanding the policy discourse, the identified views and areas of consensus (or dissent) may not necessarily apply to all stakeholder representatives at all levels.

In this Q-study, local-level experts involved in mining regulation, impact assessment, and public health in mining regions were included, as their perspectives are crucial for understanding different viewpoints and priorities from an informed standpoint. However, it is worth noting that these views may not be universally embraced across entire institutional hierarchies. Differences in perspectives may exist between different levels of management within public institutions and professional organizations, where mid-level practitioners and specialists may hold distinct viewpoints from high-level executives or senior representatives.

Another consideration in interpreting the factors is that all participants (i.e., their Q-sorts) are given equal weight. However, in policy processes, not all study participants (or stakeholders) necessarily have the same level of influence. The perspectives of senior public officials, for instance, may carry disproportionate weight. Therefore, it is important to consider the relative influence and power dynamics of different stakeholders when utilizing the findings of the Q-study to inform a policy process. Finally, it is important to point out that low Q-scores do not necessarily indicate that stakeholders do not attach importance to an issue, as low-salience rankings by individual sorters may merely indicate a stronger preference for other issues (cf. Webler et al., 2009).

Despite these in-built limitations, our Q-study contributes to a deeper understanding of the policy space and potential building blocks to promote public health in the context of mining activities in Burkina Faso. This underscores the usefulness of Q-methodology in policy research, highlighting its potential to guide policy formulation and advancement – an area where its use still limited (*cf.* Molenveld, 2020).

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Author statement

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Declaration of competing interest

None; the authors declare no conflict of interest.

Appendix A

Table A.1
Original items in the Q-sample

No.	Q-statement
S1	Les EIE sont suffisantes. Pas besoin de mesures additionnelles pour la santé publique.
S2	Les compagnies minières doivent décider par elles-mêmes comment aborder la question de la santé publique.
S3	Demander une EIS séparée va surcharger les compagnies minières et différer les investissements.
S4	Avec les exigences actuelles en matière d'EIE, les compagnies peuvent inclure des considérations sur la santé publique. C'est suffisant.
S5	Les exigences en matière d'EIE doivent être révisées pour prendre en compte la santé publique.
S6	Demander une EIS séparée surchargerait de travail les autorités délivrant les permis d'exploitation et créerait des barrières bureaucratiques.
S7	Le gouvernement doit demander aux compagnies minières une EIS en supplément de l'EIE pour atténuer les impacts sanitaires négatifs.
S8	Les permis d'exploitation minière ne doivent pas être alloués ou renouvelles sans un « plan de gestion de la santé publique».
S9	Renforcer la capacité technique du MEEVCC pour évaluer les aspects concernant la santé publique dans les EIE.
S10	Renforcer la capacité technique du MS pour évaluer les aspects concernant la santé publique dans les évaluations d'impact.
S11	Des indicateurs de santé de référence doivent être collectés pour évaluer les impacts des projets miniers sur la santé.
S12	Le MS doit fournir aux compagnies minières des directives méthodologiques claires pour mener des EIS.
S13	Les embauches du personnel technique et de contrôle doivent être protégées pour éviter les interférences politiques.
S14	Un département doit être créé au sein du MS pour surveiller les impacts sanitaires des projets industriels d'exploitation minière.
S15	Les compagnies minières peuvent divulguer volontairement l'information sur les impacts sanitaires aux communautés locales.
S16	Le MS a besoin de plus de ressources financières pour contrôler la gestion de la santé publique par les compagnies minières.
S17	Le MS doit divulguer annuellement les résultats provenant du contrôle de la santé publique dans les zones d'exploitation minière.
S18	Seuls des inspections régulières par des fonctionnaires publics garantissent l'adhésion des compagnies minières aux mesures de protection de la santé publique.
S19	Le gouvernement doit modifier les règlements sur l'exploitation minière pour renforcer le contrôle de la « performance sanitaire » des compagnies minières.
S20	Le contrôle des impacts sur la santé publique doit être laissé aux compagnies minières qui peuvent publier des rapports de contrôle annuels.
S21	La capacité à mettre en place des audits sur la santé devrait être renforcée dans les département et les administrations régionales.
S22	Le MS doit être impliqué directement dans les inspections régulières de sites d'exploitation minière et la mesure des polluants.

(*continued on next page*)

Table A.1 (*continued*)

No.	Q-statement
S23	Le gouvernement doit établir des sanctions claires pour pénaliser le non-respect des règlements de santé publique.
S24	Quand les projets d'exploitation minière sont déclassés, les plans de réhabilitation des compagnies minières doivent prendre en compte la santé publique.
S25	Créer un forum formel entre le gouvernement, la société civile, le milieu académique et le secteur privé pour discuter les défis sanitaires relatifs à l'exploitation minière.
S26	Etablir un centre d'expertise dans une université ou un centre de recherche pour former les fonctionnaires aux EIS.
S27	La coordination entre ceux responsables pour délivrer les permis d'exploitation, et ceux responsables du contrôle doit être intensifiée.
S28	Le MS doit avoir un rôle formel dans le processus de délivrance des permis d'exploitation minière pour garantir la prise en compte des EIS dans les EIE.
S29	L'avis technique du MS sur les évaluations d'impact doit être publié pour éviter qu'il soit ignoré durant le processus de décision final.
S30	Renforcer la commission technique de coordination de délivrance des permis d'exploitation pour que ses résultats ne soient pas ignorés,
S31	Au début de chaque EI, les compagnies doivent mener des consultations sur la santé avec les professionnels de santé locaux, les groupes de femmes et de société civile, et les communautés.
S32	Les compagnies doivent partager les résultats de leur EIS de manière compréhensible pour les citoyens et les membres illettrés des communautés.
S33	Le gouvernement est responsable des services de santé publique des zones d'exploitation minière: fourniture de l'équipement médical, des médicaments, et formation du personnel médical
S34	Le gouvernement doit établir une plateforme de coordination entre le système de santé local et les compagnies minières, pour s'assurer que les projets de santé bénéficient aux communautés locales.
S35	Les compagnies minières doivent communiquer leur période de candidature pour les projets de RSE afin que les acteurs du système de santé puissent soumettre des propositions.
S36	Les compagnies minières doivent financer des études de contrôle sanitaire régulières dans les zones d'exploitation minière.
S37	Les compagnies minières doivent être obligées de mener des campagnes régulières de sensibilisation sur la santé publique.
S38	Les compagnies minières doivent être obligées de financer des biens et des équipements pour les services de santé locaux, y compris des ambulances et un laboratoire médical pour des tests sanitaires.
S39	Les compagnies doivent gérer un centre de santé ouvert au public.
S40	Les compagnies minières doivent communiquer publiquement leurs réponses aux griefs et plaintes ayant trait à la santé.

Table A.2
Factor characteristics

	Factor 1	Factor 2
Number of defining variables	9.00	6.00
Average relative coefficient	0.80	0.80
Composite reliability	0.97297	0.96
Standard error of factor *z* scores	0.1644	0.20

Table A.3
List of study participants

BF01-01	Senior public official from the Burkinabe Ministry of Mines and Quarries (MMC)
BF01-02	Senior public official from the Burkinabe Ministry of Mines and Quarries (MMC)
BF01-03	High-ranking public official from the Burkinabe Ministry of Mines and Quarries (MMC)
BF02-01	Senior public official from the Burkinabe Ministry of Health and Hygiene (MoH)
BF02-02	Senior public official from the Burkinabe Ministry of Health and Hygiene (MoH)
BF02-03	Senior public official from the Burkinabe Ministry of Health and Hygiene (MoH)
BF03-01	Senior public official from the Burkinabe Ministry of Ministry of Environment, Green Economy and Climate Change (MVECC)
BF03-02	Senior public official from the Burkinabe Ministry of Ministry of Environment, Green Economy and Climate Change (MVECC)
BF03-03	Senior public official from the Burkinabe Ministry of Ministry of Environment, Green Economy and Climate Change (MVECC)
BF04-01	Representative of a large-scale mining company in Burkina Faso (company A)
BF04-02	Representative of a large-scale mining company in Burkina Faso (company B)
BF05-01	Director of a private consultancy firm active in Burkina Faso (company C)
BF05-02	Representative of a private consultancy firm active in Burkina Faso (company D)
BF06-01	Representative of a local civil society organization (CSO) (organization A)
BF06-02	Representative of a local civil society organization (CSO) (organization B)
BF06-03	Local representative of an international development NGO (organization C)
BF06-04	Local representative of the Extractive Industries Transparency Initiative (ITIE-BF)
BF07-01	Representative of the Burkinabe Chamber of Mines (CMB)

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